REPAIR AND PRESERVATION
OF
RECORDS

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REPAIR AND PRESERVATION OF RECORDS

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PREFACE

The increasing awareness of the importance of records for administration as well as for historical research has given rise to a demand for their proper preservation, whether they are in public, semi-public, or private custody. It is felt that those who are entrusted with their care and upkeep must, in order to discharge their responsibilities efficiently, be familiar with the general aspects of records preservation. A scientific knowledge of the physical and chemical properties of record materials and the effect of atmospheric impurities on them will lead to the provision of storage conditions calculated to increase the longevity of the records.

The National Archives of India has been supplying information on the care and repair of records, books, and manuscripts, whenever asked to do so. The number of such enquiries is on the increase and the need has, therefore, been felt for some time for a brochure which would, in simple language, make available to all those interested in the subject the knowledge of the technique of preservation. This brochure, it is hoped, will meet this demand.

Besides discussing the optimum storage condition needed for the preservation of records in the tropical climate, mention has also been made of some common pests injurious to record materials and the methods that should be adopted in record offices and libraries for the control of these pests. Since old and fragile records often need reinforcement in order to be safely handled, some general repair processes have also been described in detail. Further, a few special problems, e.g., treatment of water-soaked records, repair and mounting of maps and preservation of manuscripts on birch bark and palm leaf, have been discussed.

In a small brochure like this it is not possible to envisage and suggest solutions to all the problems which may arise

in dealing with special cases. Solution of such problems may also require expert advice on the spot. Within such limitations it is hoped the brochure in its present form would be found useful by all who are entrusted with the custody of the written word.

It is my pleasant duty to put on record my appreciation of the help given by my colleague, Shri R. C. Gupta, Deputy Director of Archives and the staff of the Preservation Division in preparing the manuscript.

K. D. BHARGAVA
Director of Archives,
Government of India.

NEW DELHI,
Dated the 1st September, 1959.

I. PRESERVATION OF RECORDS

Deterioration of paper which has been used for writing and printing purposes during the past few centuries is quite common. In certain cases it has been observed that paper in recorded files and books which have not even been much used has yellowed and become brittle. In case of modern papers the deterioration is more quick. These changes depend on the chemical composition of paper and ink, and are influenced to a large extent by the storage conditions. Preservation of records, therefore, not only requires maintenance of ideal storage conditions, but also judicious selection of paper and ink for writing.

Selection of record materials, paper and ink

Grades of pulp used in the manufacture of paper, the extent of bleaching, the quality and amount of sizing and loading materials used and the total acidity in paper determine its value for permanent preservation. Specifications of paper expected to last permanently have been laid down in many countries like U.S.A., U.K., etc. These are also under the consideration of the Indian Standards Institution. Excessive acidity in ink is also a factor in degrading even good quality paper. Specifications for writing inks for permanent records have been laid down by the Indian Standards Institution *IS* : 221-1950. The specifications will help the various agencies interested in the preservation of their records in selecting the proper grades of materials for use in records.

Influence of climatic conditions, temperature and humidity

Paper and other record components, e.g., leather, sewing thread, board, paste, glue etc., used in binding, are affected by high temperature, too high or too low humidity, dust and acidic gases in the atmosphere and sunlight. Paper kept in a hot and dry climate becomes brittle; leather and board get desiccated under similar conditions. In the presence of excessive humidity paper often tends to crumple and becomes soggy.

Extreme variations in temperature such as 10° C (50° F) in winter and 45°C (113° F) in summer experienced in many places in India, also affect the flexibility of these materials.

Temperature and relative humidity of the atmosphere above 32°C (90°F) and 70% respectively result in the growth and propagation of pests like book-worms, silver-fish, cockroaches and termites etc., as well as a variety of fungus commonly known as mildew.

Atmospheric pollution : acidic gases and dust

The presence of acidic gases in the atmosphere, especially sulphur dioxide and sulphurated hydrogen in the polluted air in industrial towns has a deleterious influence on paper. It has been observed that the paper used for records and books kept in a city deteriorates more rapidly than that stored in the suburbs. Dust particles present on paper, leather, board etc., act as nuclei for the condensation of acidic gases and propagation of mildew spores. These particles get embedded in paper, leather etc. and subsequent flexing of these materials produces an abrasive effect on their surfaces and damages the fibres. Their presence on these organic materials creates unhygienic conditions and favours the growth of mildew.

Direct sunlight

Direct sunlight is regarded as an enemy of records. The phenomenon of discolouration and eventual deterioration of news-print or other similar paper made of mechanical wood pulp when exposed to direct sunlight for prolonged hours, is very common. Besides, gradual fading of dyestuffs in writing ink is also accelerated by exposure to sunlight.

Storage conditions : regulation of temperature, relative humidity, airconditioning

It has been observed that maintenance of controlled temperature and humidity of the air in the storage area is of considerable value in preserving records. Temperature and relative humidity most suitable for the proper preservation of paper and other record materials range between 22-25.5°C (72°-78°F) and 45-55% respectively. Regulation of temperature and relative

humidity in the above range is only possible with the help of an elaborate airconditioning plant. In the airconditioning system it is also possible to treat the air with alkaline water having pH 8.6 or above, so that acidic gases in the atmosphere may be neutralized. Heavy dust particles are also eliminated in the air-wash system.

Dehumidification by dehydrating chemicals

Airconditioning involves high initial cost of installation and may not be within the means of comparatively smaller record offices and libraries in India. In the absence of airconditioning the only method of minimizing the deleterious influence of excessively high humidity is the use of dehydrating agents. Anhydrous calcium chloride and silica gel are quite satisfactory as dehydrating chemicals for use in record offices. Although initial expenditure in silica gel dehumidification may be more than calcium chloride, yet it is economical in the long run as silica gel can be reactivated for re-use after heating the saturated chemical in open pans. The quantity of silica gel to be used for a specific room capacity will depend on room temperature, rate of air circulation and moisture content of the outside atmosphere. However, approximately 4-5 lbs. of silica gel may be sufficient for a room of 600-800 cubic feet. The requisite quantities of silica gel may be spread in dishes and kept in different places in the room. Use of silica gel in wire net pockets fixed on wooden frame and kept on shelves may give better results. After use for 3-4 hours the silica gel may get saturated and need replacement with fresh chemical, while the saturated chemical may be reactivated for further use.

Since stagnant air, combined with high humidity, accelerates the decomposition of materials and also favours the growth of injurious pests, fresh air circulation in every portion of the record room is very helpful in checking the growth of these pests. An adequate number of windows and ventilators ensures good circulation of air, but at times it may be necessary to circulate the air inside the room with electric fans. Dry artificial heat obtained by the use of electric radiators and stoves is one of the effective means of reducing excessively high humidity in record rooms. Use of such appliances will evidently raise

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room temperature which in itself may be above the limits already mentioned and is harmful to record materials. This process is hardly applicable in tropical climate except in the hills in the winter months and as such it should be adopted with care in such cases. It is, however, necessary that documents are not stored in the vicinity of such heaters or radiators.

Storage conditions: record rooms and stack equipment

It has already been observed that dampness not only accelerates decay of organic materials but also provides favourable condition for propagation of mildew and pests like silver-fish, cockroaches, termites etc. Care is, therefore, necessary to see that the record room is not damp and that its walls, flooring etc., have no crevices. Selection of record rooms and shelving equipment play an important role in preserving records.

Whereas provision of cross windows and ventilators for air circulation is necessary, it is also to be ensured that no direct sunlight finds access to the stored materials. In record offices exposed to too much sunlight it is desirable to provide windows and ventilators with glass panes and screens and keep them closed.

Open shelves are necessary for accessibility of air in every portion of the stacked materials. An additional advantage with such shelves is that they facilitate servicing work, which is rather difficult if closed *almirahs* are used. Iron shelves seem preferable to wooden ones since wood itself requires care and chemical treatment against certain pests, amongst which termite is its most voracious enemy. It is preferable to avoid contact of racks with walls so as to eliminate damp dark pockets where insects breed. For similar reasons shelves made of concrete and supported in walls do not make ideal storage arrangement. The present day trend is to install adjustable metal shelves so that spacing between individual shelves can be adjusted to suit the size and bulk of the record materials.

Injurious pests and their control : mildew

Incidence of mildew or moulds in books and volumes is very common in a hot and humid climate. While moulds include all

kinds of organism which grow on paper, leather, textiles, etc., mildew is the term popularly used to designate a variety of vegetable organism among fungi. These micro-organisms grow very slowly at low temperatures, 4.5°C (40° F) and rapidly at optimum temperature, 27-35°C(80-95°F), differing with different species. At high temperatures, above 38° C (100° F), most of these organisms cannot live. The spores of these species remain suspended in air and can be carried over long distances. Growth of these micro-organisms is usually detected by the presence of brownish to greenish black patches on leather, paper, etc. These species are capable of causing stains on paper, technically known as 'foxing'. It has been found by experience that mildew is common in volumes and books which remain pressed against each other. This is due to the fact that when books are pressed one against the other, the intervening atmosphere is reduced to a thin flat stagnant air pocket which favours the growth of mildew. Books and volumes loosely shelved are not generally so mildewed.

Fresh air supply and maintenance of temperature and relative humidity in the range 22-24° C (72-75 °F) and 45-55% respectively, check the growth of these species. If regulation of temperature and relative humidity within the above limits is not feasible, the growth of these micro-organisms can be retarded to a considerable extent by maintaining thorough air circulation in the room with the help of electric fans. In case mildew or mould infestation has already occurred in books and volumes, the only means of eliminating it is to fumigate the infested materials with thymol. Thymol fumigation, the details of which are described below, kills but does not remove the organism or any accompanying stain.

Thymol fumigation

A suitable apparatus for thymol fumigation can be made by adapting an air-tight cupboard or box. The volumes to be fumigated are supported some 6 inches from the bottom of the cupboard on a framework of wire net. A 100watt electric lamp is installed at the base of the cupboard over which thymol contained in a dish is heated. The files or volumes are opened in an inverted 'V' form with the stitched or bound part forming the

apex. On heating, thymol vaporises and the closed space inside the air-tight cupboard becomes saturated with thymol which destroys the mildew growth. A concentration of one to two ounces of thymol per 10 cubic feet is often sufficient, and the time of fumigation varies from six to ten days, the heating of thymol being necessary for two to four hours every day. Records infested with mildew should be first cleaned and then fumigated. The fluffy surface growths can be cleaned with soft cotton wool. Care should be taken to prevent scattering of spores in the process of cleaning.

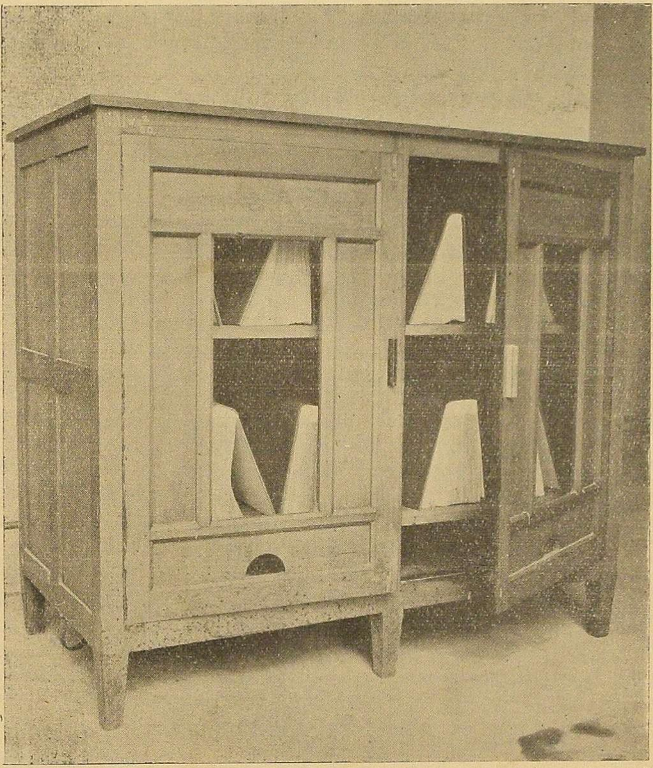
The sterilization of the atmosphere of the room by spraying a 10% solution of thymol in methylated spirit will check the growth of spores present in a record room where there is no adequate arrangement for bringing down the humidity below 75% during the rains. Since thymol vapours are pungent, it is advisable to spray thymol solution at the close of the day, since the room and windows can be kept closed overnight.

Insects : cockroaches and silver-fish

Damage done to books and records by insects is often considerable. Perhaps no repository is completely free from the depredations of insects. Cockroaches and silver-fish are two surface feeders which generally damage the outside of the volume, viz., binding fabrics, leather, board, etc. Silver-fish is a tiny insect with glistening silver grey scales. It is frequently found on damp walls in warm and humid climate and feeds upon record materials and textiles. These insects do not multiply rapidly but are difficult to eradicate.

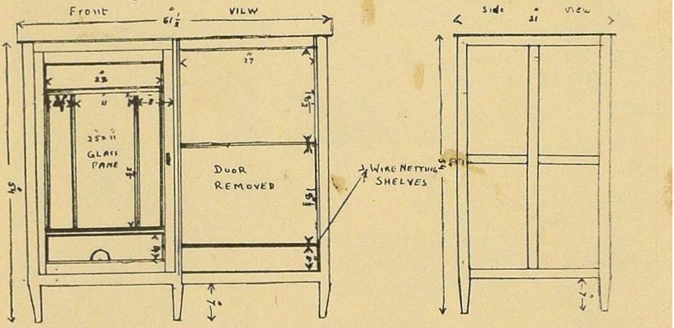
Cockroaches are too well known to need description. They are closely related to grasshoppers and crickets and are dark brown in colour having two protruding antennae. There are a number of varieties of these species, out of which common household cockroach is omnivorous. exhibiting a marked liking for sweetened and starchy materials. During day they retire to dark and damp corners or rest in crevices, but roam all over at night in search of food.

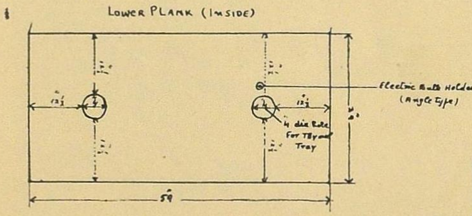
Under favourable conditions insects multiply very rapidly. Vigilance and preventive measures therefore become necessary



Thymol Fumigation

SKETCH OF THYMOL FUMIGATION CHAMBER





Drawn by R. Jain
National Archives
New Delhi
Date. 19-6 1959

As a matter of fact insects are invariably attracted by edibles which should be forbidden in a record room or library. Avoiding dark and damp condition in the room, and filling up all the crevices in walls and floors with cement will eliminate the conditions favourable for their breeding. Use of insect-repellent chemicals like naphthalene reduces chances of insect attack. It seems a good practice to keep naphthalene bricks every six feet or so on the shelves. Complete annihilation of these insects requires the use of poisonous dust powders, D.D.T., pyrethrum, sodium flouride, etc., or commercial spray insecticides. These poisonous powders and insecticidal liquids are sprayed in places frequented by these insects, i.e., dark corners, crevices, walls, etc. While using these poisonous dusts or insecticidal liquids available in the market, care is necessary to ensure that the spray is directed to the walls, dark corners and crevices frequented by the insects, and not to the books and records. Direct spray of these toxic chemicals on records might not only stain them, but also prove harmful to those who handle these records.

Book-worms and psocids

Besides cockroaches and silver-fish, there are other insects like book-worms and psocids. Psocids are commonly known as book lice, and are more dangerous in their damage to record materials than the surface feeders. Since the infestation of these species usually starts in the spine and the joints between the boards of bound volumes, it is difficult to detect them till considerable damage has been done. *Gastrallus indicus* i.e., book-worm or book beetle as it is commonly known, has two stages of development, viz., larvae or grubs and fully winged beetle. The larvae or grubs generally travel from the surface down the bulk of the volumes and cause damage in the form of pinholes and empty parallel sided tunnels, while beetle is the main cause of spreading the infestation to other uninfested records.

Fumigation with lethal gases : para-dichloro-benzene and killoptera

The most effective means of getting rid of the infestation is to treat the affected records with vapours of lethal chemicals or toxic gases Vacuum fumigation with ethylene oxide

mixed with carbon dioxide (1 : 9 by weight) is the most effective method of eliminating these dangerous enemies of records. This process of fumigation involves installation of costly equipment and perhaps only the major record repositories can afford them. For small record offices which may not be in a position to afford such expenditure, fumigation with crystals of para-dichloro-benzene or liquid killoptera (a mixture of carbon tetrachloride and ethylene dichloride) may be adopted. Fumigation may be carried out in an airtight steel *almirah,* the shelves of which are perforated. Records for fumigation are spread on the shelves and bound books or files opened and kept in inverted 'V' shape with the bound part forming the apex. If para-dichloro-benzene is used for fumigation, it is placed in a glass jar at the base of the *almirah,* 1 lb. of the chemical being provided for 10 cubic feet of space. If killoptera is used, it is placed in the uppermost shelf in the concentration of 14 lbs./1,000 cubic feet. Both the above chemicals vaporise at ordinary temperature; vapours of para-dichloro-benzene are light and rise up, while vapours of killoptera are heavy and flow downwards. The time of fumigation varies from seven to eight days. Fumigation with the above chemicals kills living larvae and active beetles, but eggs laid in furrows near the binding joints and in boards of volumes, are not affected. Since there is a possibility of their maturing into larvae in 20-21 days, a repetition of the fumigation process for complete elimination of these species is usually necessary after this period.

Termites or white ants

Another species that is more destructive to records than the insects described above are termites, commonly known as white ants. Among all the insects that damage wood and cellulosic materials, viz., paper, pulp board etc., these are the most dangerous. White ants, which are found all over India, usually build their nests in the ground and extend them into timber work and buildings. They construct covered runways over bricks and concrete, have a marked aversion to light and work in concealment. The infestation of this species is usually detected only when their infestation has become severe and considerable damage has been done to the stored

materials. Their extreme infestation is indicated by the emergence of a large number of flying termites during rains. A warning that white ants are around, is the branching shelter tubes or mud covered runways on foundation walls reaching from the ground to the wood-work or over the surface of stones, bricks, etc., which these insects cannot burrow.

Killing the live insects visible in the material is of little help since the reproductive rate is astonishingly high in this species. A female queen produces thirty thousand eggs a day on an average. Damage to buildings etc., can only be checked if measures are taken to isolate the building by digging a trench outside the foundation wall, and filling it with chemicals like coal-tar and creosote oil. Extermination of the colony itself is also necessary. Such measures for white ant eradication often require considerable experience and has perhaps to be attended to by experts in the line.

The best way to prevent damage to material against the ravages of these insects is to adopt measures that check their emergence in buildings. It is, therefore, necessary that at the very first sign of white ants in a room, all inlets from which infestation might start, i.e., joints, cracks, crevices in the floor and walls, etc., should be immediately filled up with cement and concrete. If the flooring is felt to have been hollowed from places, it should be broken at the hollowed places and filled with poisonous chemicals. White arsenic, D.D.T. powder, 1% solution of sodium arsenite in water or 5% solution of D.D.T., 1 to 2 gal. per 10 cubic feet, are quite satisfactory for the above treatment. After the treated place has become dry, it should be cemented and flooring made intact. Walls of the room should be likewise examined and treated.

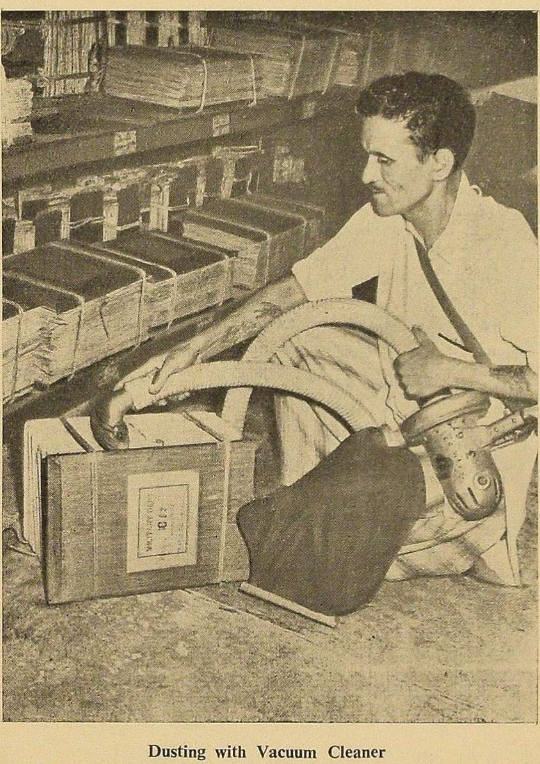
All joints of wood-work in contact with the walls should be painted with creosote oil, at least once in six months if the infestation is severe. In an infested building it is desirable to avoid the use of *almirahs* built in the walls. If wooden *almirahs* or racks are in use, they should be kept away from the walls, at a distance of six inches at least and the legs of the *almirahs* or racks painted with coal-tar or creosote oil once in six months, treatment being given once before the

rains. If possible the *almirah* or the rack may be segregated from the infested ground by placing its legs in bowls containing coal-tar or creosote oil. This will raise a chemical barrier and insects will seldom find their way to the record materials. Since this chemical is corrosive, it should be handled with care. As a precautionary measure the entire wooden structure may also be painted with 20% zinc chloride solution in water.

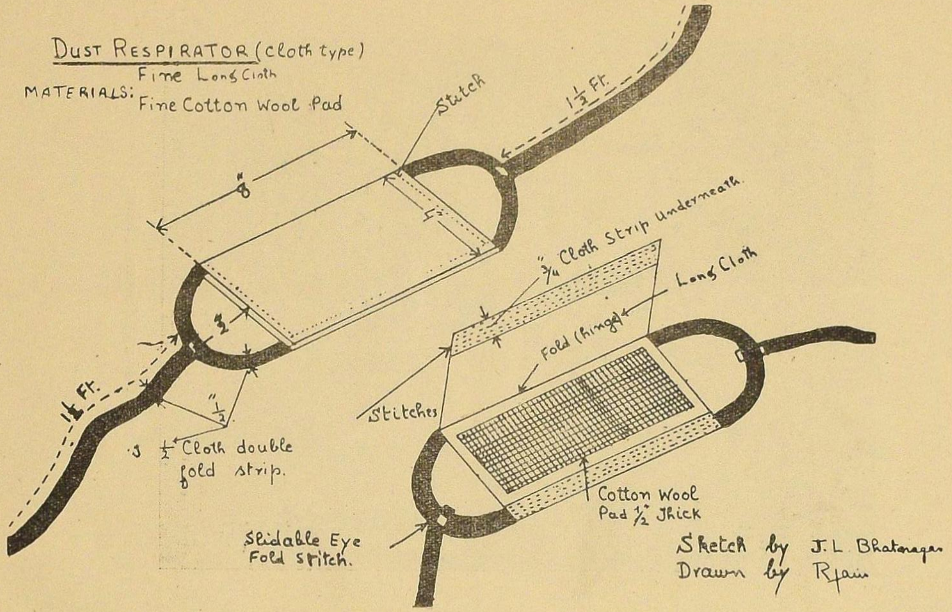
White ant infestation may occur in any building constructed at a site infested with these species. Buildings, with improperly laid foundation, defective construction, built with poor building materials or damaged by earth-quake are susceptible to white ant infestation. Neglect in maintenance may also facilitate the incidence of white ants in a building. Therefore, vigilance in attending to minor damage and repairs, and maintaining tidy conditions of storage will help protect valuable records against damage by white ants. Use of wood of poor quality for construction work, etc., also increases the possibilities of white ant damage to a building. Selection of good quality wood is, therefore, an important factor. Treated timber is available in the market and may be used for this purpose. In the absence of treated timber, hardwood of Indian timber, like teak and *shisham*, may also be used. Although racks fabricated from teak or *shisham* wood are reported to be resistant to white ant, yet the use of steel racks is preferable for record repositories and is economical in the long run.

Care in upkeep and storage

Periodic inspection of the record room will help in eliminating the possibilities of insect-attack and in maintaining tidy condition in the room. Accumulation of dust, as has been already discussed, creates favourable conditions for the growth of injurious pests, and is unhygienic for the persons who handle these materials. Besides containing hard siliceous particles, dust contains organic particles from the putrefied record components which might be containing bacteria harmful to human beings. Regular dusting with the help of electric vacuum cleaners is a vital need for every record office. Ordinary dusting with cloth pieces makes the dust particles float in the room with-



Dusting with Vacuum Cleaner



DUST RESPIRATOR (cloth type)
MATERIALS: Fine Long Cloth
Fine Cotton Wool Pad
Stitch
1½ Ft.
8"
4"
¾" Cloth Strip underneath.
Long Cloth
Fold (hinge)
½"
1½ Ft.
½"
½ Cloth double fold strip.
Stitches
Cotton Wool Pad ½" Thick
Slidable Eye Fold stitch.
Sketch by J. L. Bhatnagar
Drawn by R. Jain

out removing them from the repository and is unsatisfactory. Staff attending to dusting should preferably be provided with dust respirators to safeguard against the injurious dust particles. A cloth bag with cotton lining works as a satisfactory respirator. Cobwebs on walls, ceiling etc., should also be cleaned periodically.

In the absence of carton boxes which are ideal for the storage of records, files should be tied between two pieces of 5-ply vanista boards of size slightly larger than the files and this will avoid their warping due to variation in temperature and humidity. The boards containing the files should be tied near both ends with loglines which should go round at least twice. If only one end is tied there is unequal pressure on the two ends of the files which may result in their subsequent damage. While tying a bundle care should be taken that the logline does not cut into the edges of the files. The bundles should be kept on the shelves preferably horizontally. However, if these are kept vertically, care should be taken to ensure that the bundle is upright, there is no leaning of the bundles against each other, and that the ends of the files do not get curved under pressure. If the shelves are supported in the wall, bundles near the wall ends of the shelf should be kept at least 6″ away from the wall.

Care in handling

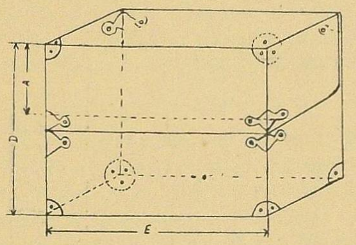
Records should be handled with care. All endeavours for proper preservation and storage will be in vain if care is not observed in handling the bundles of files or an individual file. While removing the bundles from the shelves, these should not be dragged out from their places. Instead, these should be lightly lifted with both hands, care being taken that the other bundles are not disturbed. The bundles should not be thrown on the table or floor, but should be placed gently. The file should be taken out after untying the bundle and in no case it should be dragged out. After the required file is removed and a slip provided for the file, the bundle should again be properly tied and restored on the shelf.

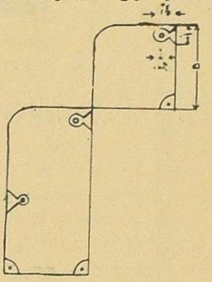
Neglect of a few simple precautions sometimes results in irreparable loss through fire accidents. Smoking should be

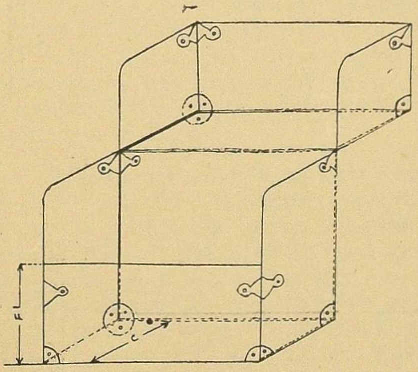
strictly prohibited in the record room and any type of open fire should also be forbidden. All electric wires should run through conduits. No chemicals should be stored in the record room. Necessary fire fighting equipment, preferably of the gas type, should always be at hand.

DIAGRAMMATIC SKETCH OF DOCUMENT CONTAINER

MATERIAL. STRONG COMPRESSED STRAW BOARD







A . $5\frac{1}{4}''$

B . $6\frac{1}{4}''$ (MINIMUM)

C . $6\frac{1}{4}''$ (INSIDE)

D . $12\frac{3}{4}''$ (INSIDE)

E . 16 (INSIDE)

F . 7 (INSIDE)

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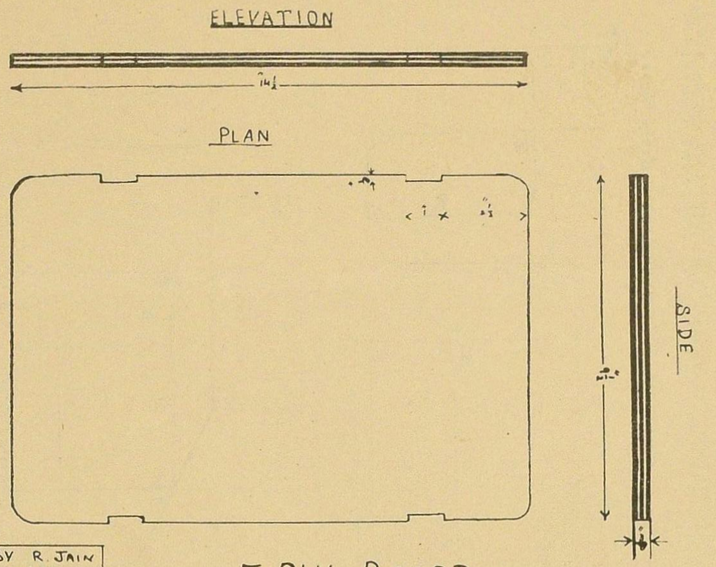
NEW DELHI
DATE . 16 6 59



5 PLY BOARD

DRAWN BY R. JAIN
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DATE 12.6.59

II. REHABILITATION OF OLD RECORDS

Records as they arrive at the repository for storage are at times in a dilapidated condition, and require minor repairs etc., to put them in a proper condition for facilitating subsequent handling and storage. Besides such care, records which might have been spoilt due to exposure to unfavourable climatic conditions and damage by insect pests also need attention.

Flattening and minor repairs

The edges and corners of papers in a file when it comes to the record room may be folded and slightly damaged due to improper tagging of the paper in the file cover. File covers themselves are at times torn and damaged, and need replacement. Therefore before a file is restored for storage on the shelf, all such minor damages which would subsequently result in major ones should be attended to. However, before the files are unstitched for flattening and minor repairs of the individual sheets it is necessary that they are paginated, so that the order of the file is kept undisturbed when the sheets after flattening and repair are restitched into files.

The edges of paper which might show crumpling tendency should be flattened. Use of moderately hot electric iron is satisfactory for the purpose. The portion to be flattened should be made damp with a wet sponge, covered with blotting paper and ironed. If there are creases in the paper these should also be removed with ironing. If there are minor tears they should be repaired by pasting strips of good quality hand-made paper (all rag) at the back of the torn portion. If the portion where the tear exists is written on both sides it could be mended by pasting strips of thin tissue paper on both sides of the tear. Torn and damaged covers could also be mended likewise, or replaced with new covers. In most of the papers the damage is usually confined to the edges of sheets either on the open side or the stitched side. Such damaged portion may also be reinforced by

pasting slips of all rag hand-made paper at the back, care being taken that if there is writing on the back, the same is not covered in the mending process. The slips should be uniform in breadth, and for most of the minor repairs slips of ½″ or ⅝″ breadth will be quite satisfactory.

While selecting adhesives for repair work, use of gum or glue should be always avoided. Both the above materials swell in water and shrink on drying. Binders paste prepared with *maida* to which some copper sulphate (2-3%) has been added is quite satisfactory for the purpose. *Maida* paste when kept for 2-3 days tend to develop fungs and often loses its adhesive properties and, therefore, it is advisable to prepare fresh paste when mending is to be done. If tissue paper is used for repair, dextrine or thin starch paste should be used for maintaining legibility of the writing. Preparation and formulae of the dextrine paste and starch paste are given in Appendix III.

Docketing

After the individual sheets have been attended to for minor repairs, these should be properly put in a thick docket cover and sewn. The size of the cover should be slightly larger than the size of the document. If there is not enough margin on the document for sewing purposes, (the writing may be extending upto the margin) a flap of 1″ to 1½″ breadth may be pasted along the margin. The process of flapping is technically known as guarding. The length of the guard should preferably be equal to that of the document. Use of all rag hand-made paper or good quality writing paper is preferable for making guards or flaps. One advantage in guarding is that the individual sheets could be made up into pairs or sections sewn to the cover through the folds of the guard. After the subject matter of the file and its number are recorded on the cover, it is ready for storage.

Other repair processes

Paper in many records might have become so much creased, folded or fragile that it needs reinforcement for its preservation. Processes of repair to be adopted for a particular document will

depend on the condition and form of the document to be preserved. The methods of repair adopted in a record office are full pasting, tissue repair, chiffon repair and lamination. Lamination of documents with cellulose acetate foils carried out in a hydraulic or rotary press with the application of heat and pressure is the most modern method of reinforcing brittle documents. In the National Archives of India tissue paper is invariably incorporated for strengthening the document during lamination. Since the initial cost of installation of a suitable laminating press and its accessories may run to over one hundred thousand rupees, such a press may not be within the means of every record office in India. Using acetone as a solvent, documents can be repaired by hand with cellulose acetate foil and tissue paper on a limited scale without any mechanical equipment.

Full-pasting

Brittle documents which are written on one side may be strengthened by pasting all rag hand-made paper at the back. Before this is done all slips etc., which might have been pasted at the back of the document should be removed. For this purpose the document should be placed in between two oiled or waxed papers, and immersed in lukewarm water for half an hour to an hour when the paste or adhesive in the pasted slips will become softened and the slips can be peeled off easily. While immersing the document in water care is necessary to ensure beforehand that the ink does not get washed. If the ink shows spreading tendencies when in contact with water, the document should never be immersed in water. In such a case the pasted slips could be dampened by placing over them wet blotting paper slips of the same size. After the paste becomes soft the slip of paper should be peeled off and all rag hand-made paper should be pasted over the document. The size of the paper for full-pasting should be slightly bigger than the size of the document to be pasted over. The paper to be used for pasting is immersed in water and spread on a table with a glass top or if a wooden table is in use, on a waxed or oiled paper smoothened with a soft cloth piece, and then rolled lengthwise. The document which is to be reinforced is placed face down on the oiled paper and a coat of starch paste applied with a brush.

The rolled up hand-made paper is then placed on the edge of the document and unrolled on it, the unrolled paper being pressed simultaneously with a dry piece of cloth or cotton swab. The pasted document is then removed from the oiled or waxed paper and allowed to dry under pressure with reinforced side downward. The oversize hand-made paper is then trimmed with a pair of hand scissors to the size of the document keeping a margin of 1/10th of an inch all round to safeguard the edges of the document when in use.

Chiffon repair

Chiffon or fine transparent silk guaze is used for repairing extremely fragile, ink or insect damaged documents. Before undertaking repair with chiffon all the slips and patches pasted on the document should be removed as described before. After removal of the patches the document which is ready on a waxed or oiled paper is covered with a chiffon or silk piece slightly larger than the document, and dextrine paste is applied to the chiffon piece with a brush starting from the centre and spreading outwards. When the entire document has been so covered and treated with the paste, the assembly is turned over on another waxed or oiled paper. The first oiled or waxed paper which will be now on top is carefully removed so that the document assembly remains intact on the second oiled or waxed paper. The process of pasting of chiffon piece is now repeated on the top side. After the chiffon has been fixed on both sides of the document, care being taken to avoid creasing of the fabric, the sandwiched document is allowed to dry. The semi-dried document enclosed in between two waxed or oiled papers should be kept pressed in a hand press or between two hard boards with weights over them. After the documents have been pressed (over night), these should be removed from oiled or waxed paper, edges of protruding chiffon trimmed, the documents stitched and docketed as described earlier.

In case the ink of the documents is soluble in water they should preferably be repaired by hand lamination process described below. If documents containing water soluble inks are to be repaired with chiffon the process adopted should be as follows : A piece of chiffon, larger than the document is spread on the waxed or oiled paper and dextrine paste applied on it with

a brush. The document is then spread gently over the chiffon and pressed under a waxed paper. Another piece of chiffon of the same size as the first one is again spread on a waxed or oiled paper and dextrine paste applied to it as in the first case. The document to which chiffon has been applied on one side is taken off from the waxed paper and the untreated side of it placed on the paste-treated chiffon, and pressed under a waxed paper. The waxed paper from the top is removed without disturbing the sandwitch which is then allowed to dry. The document may then be treated for subsequent processes as described earlier.

Tissue repair

Documents, writings on which have not faded and which show only slight deterioration, can be reinforced with fine quality tissue paper. Only unsized imitation Japanese tissue paper, free from oily and waxy constituents, should be used. The sheet to be reinforced is spread on a waxed or oiled paper and dextrine paste is applied to it in thin layer. Tissue paper larger than the document in size is placed on one side of the document and spread lightly from one edge of the document to the other, the tissue which comes in contact with the document being simultaneously pressed with a wet cloth or cotton swab. The other side of the document is similarly treated.

If dextrine paste is not available, thin starch or *maida* paste can also be used for chiffon or tissue repair. The formulae of the pastes are described in Appendix III.

Hand lamination process

In the hand lamination process acetone is used to make cellulose acetate semi-plastic, which on drying forms a bond between the tissue paper and the document. Unlike machine lamination this process does not need use of heat and pressure and no elaborate equipment is required. In the process of hand lamination the document that requires reinforcement is placed on a polished glass plate. A sheet of cellulose acetate foil is then placed over the document and a sheet of tissue paper is

spread gently over the cellulose acetate foil covering the document. The size of cellulose acetate foil and tissue paper should be slightly larger than the size of the document. A cotton swab dipped in acetone is gently rubbed over the tissue paper. Small quantities of acetone from the cotton swab penetrate the tissue paper and reach the cellulose acetate foil which gets swelled up, and on drying binds the tissue with the document. Care, however, is taken that the cotton swab is only lightly pressed otherwise excess quantity of acetone will be released and dissolve the acetate foil completely at places, which will subsequently show as patches on tissue paper. The reverse side of the document is likewise treated and the document dried under pressure as in chiffon and tissue repair.

One advantage of the above process is that even water soluble colours and inks do not show spreading tendencies and, therefore, the process can be easily applied to documents containing such colours or inks. Instead of tissue paper, chiffon may also be used in the hand lamination process.

Rehabilitation processes as described above need practice and craftsmanship on the part of the mender attending to them. The work should only be entrusted to those who are trained in it; for there is every possibility that the fragile document may be further damaged by an unskilled person.

Binding

As already described the individual sheets of a file after they have been attended to for minor repairs or major reinforcement described above, are compiled and stitched into a docket. Guarding of sheets where writing extends into the margin has already been described. However, if the file is bulky and contains, say, more than 100 pages, ordinary stitching in docket covers does not provide sufficient protection against damage from handling and use. In such cases it would be worthwhile to bind the file. Ordinarily all bulky files which have permanent value should be bound in parts. Like the rehabilitation processes described in the preceding pages, binding is also a technical job and needs trained craftsmen.

Repair of maps and charts

Maps and charts more than double foolscap in size are reinforced by mounting them on *malmal* or long-cloth. The mounting cloth is moistened in water and stretched on the table and fixed to it with thumb tacks. The map or chart to be mounted is cleaned and flattened. It is placed face down on a waxed or oiled paper and paste is applied to its back. It is then transferred from the oiled paper to the stretched cloth and pressed. The piece of cloth used for mounting should always be some inches larger than the size of the map or chart to be reinforced. The mounted map is allowed to dry in taut condition. When dry, the surplus portion of the backing cloth is trimmed, keeping a margin of ¼″ all round which is then turned back and pasted. This protects the edges of the map.

Charts and maps that are to be stored flat or in rolls are mounted in one piece, while those that must be folded are cut before mounting along the fold lines. This is known as "sectioning." The individual pieces are mounted in proper positions on a single piece of muslin or long-cloth, leaving spaces of 1/16 to 1/8″ between the individual pieces, depending on the thickness of the paper, and the number of folds.

Since map mounting is a highly specialized job, it should be attended to only by trained personnel.

Water damaged Records

Records that have been affected by water should be treated immediately after the exposure in order to avoid their decay and attack by mildew. After preliminary squeezing out of water from the bundles or files, they are spread open inside a room under a fan. Wet papers should then be carefully separated from one another. If these papers show a tendency to stick, use of dull paper knives should be made for separating the sheets. The individual sheets should be then interleaved with waxed paper or blotting paper and again pressed to squeeze out any residual water. These should then be allowed to dry in a room under a fan. Where no fan is available the doors and the

windows of the room should be kept open for free circulation of air and the documents or records should be often turned in such a way that every portion is exposed to air. The paper should never be dried by direct exposure to heaters or sunlight. For drying, papers should be spread on tables or hung over cords. After the papers have been dried these should either be flattened with an electric iron or kept under pressure.

Papers that have dried in a mass and have stuck together, have to be carefully handled for separation. These papers should be humidified or dampened by keeping in between blotting papers before attempting their separation.

Besides the problems discussed in the foregoing paragraphs there may be other problems in a record office, e.g., rehabilitation of charred documents, faded and washed out writings, seals affixed to documents etc. Treatment in such specific cases might require the attention of personnel trained in the science of preservation and repair of records. Expert advice should, therefore, always be sought for, so that the rehabilitation of these materials can be attended to without causing any furher damage to the old and fragile documents.

III. CARE AND REPAIR OF MANUSCRIPTS ON BIRCH BARK AND PALM LEAF

Birch bark and palm leaf have been used for writing purposes much before the advent of paper in India. Birch tree is mostly Himalayan in origin and a number of birch bark manuscripts belonging to the 6th-7th century A.D. exist in Kashmir. Palm tree is very common in South India, Bihar and Bengal, and its leaves have been more widely used than the former. A large number of palm leaf manuscripts exist in the custody of various organisations and individuals throughout the country. Most of the palm leaf collections date back to the 11th or 12th century A.D. Manuscripts written as early as late Gupta period, 7th century A.D., are reported to be in Nepal.

Birch bark sheets used for writing purposes usually consist of a number of thin layers pressed together as they occur in nature, while palm leaves used for writing are reported to be of two varieties, i.e., *tala* and *sritala*. *Tala* leaf is thick and coarse and is difficult to handle. It does not absorb writing ink, and therefore characters have to be inscribed with a stylus on the surface and filled in with a pigment viz., carbon. *Sritala* leaf is thin, flexible, beautiful, and can be handled like paper. Since birch bark and *sritala* leaves absorb ink, carbon ink has been used for writing purposes. This ink in certain cases does not get washed by water.

Storage conditions

The conditions of storage suited for the safe upkeep of birch bark and palm leaf manuscripts are similar to those required for paper, i.e., temperature in the range of 22-25.5 °C (72-78 °F[9]) and relative humidity 45–55%. The methods of maintenance of temperature and humidity within these ranges have already been discussed earlier. In the absence of proper storage conditions, the thin surface layers of birch bark tend to separate and the edges of birch bark and palm leaf get curled up and show crumpling tendencies due to desiccation.

Besides controlled temperature and humidity, the manner of storage has an important bearing on the state of preservation of these materials. Various practices have been in use for storing these manuscripts. To collect the manuscripts in a bundle and tie them in between two wooden boards has been the most common practice. In the case of palm leaf manuscripts a different practice is very much in vogue. The manuscript leaves have centre holes through which a cord is passed for collecting the leaves and the loose ends of the cords are passed through similar holes in the boards in between which the manuscript is tied. This latter method is not very satisfactory, since slight uneven pressure is likely to damage the leaves at the edges of the hole. There is also the practice of keeping the manuscripts in bundles either tied in between boards or wrapped in cloth *bastas*. Although keeping the manuscripts in *bastas* protects them from dust and other surface feeders, care and caution in tying a *basta* is very essential. The manuscripts kept in bundles or *bastas,* if brittle, are likely to be damaged under pressure. The best method of storing these manuscripts is to keep them in loose leaves in boxes made of card-board or wood. The size of the box should be slightly bigger than the manuscript sheet so that the manuscript could be easily taken out from the box with least friction between the edges of the leaves and the sides of the box.

Protection against insect pests

Birch bark contains some natural preservative chemicals (salts of salicylic acid) and insect pests have not been found to attack it, while palm leaf is easily attacked by insect pests. And the most common species which infest this material is *Gastrallus Indicus*. In case of an infestation, fumigation of the infested material with para-dichloro-benzene or killoptera is the only method for eliminating the infestation. Details of the fumigation process have been described earlier.

Use of preservative chemicals protects these manuscripts from insect attack. *Pandri,* a type of grass, and *Ghora Bach,* a herb known as *acorus calamus,* have been used in the past with success. These preservatives are tied in cloth and kept

among manuscript bundles or in *bastas* containing the manuscripts. The active constituent in the grass and the herb mentioned above is an essential oil whose fragrance keeps the insects away. After the oil has volatilized, these materials lose their repellent properties. Strong insect-repellent chemicals like naphthalene or camphor are now available, and their use is considered to be more effective than the vegetable products described above.

Repair and restoration of brittle and faded manuscripts

Old and brittle birch bark or palm leaf manuscript sheets often require reinforcement for their safe upkeep. Chiffon repair as described earlier provides satisfactory reinforcement for both types of manuscripts. Since a small fraction (1/16th of an inch) of chiffon is left protruding round the edges, satisfactory protection is provided to these edges of the sheets. However, for extra protection, the chiffon-reinforced sheet could be inlaid in a frame of hand-made paper or pulp-board of suitable thickness depending upon the thickness of the manuscript leaf. Inlaying makes the handling of these leaves safe.

Dust accumulates on palm leaf and birch bark manuscripts if kept improperly and the writing is erased thereby. Manuscripts where the ink is not washable in water could be cleaned with a solution of glycerine in water (1 : 1), while those where the ink is soluble in water, could be cleaned with carbon tetrachloride or acetone. Palm leaf manuscripts written in carbon ink, if faded, cannot be restored, while in case of those inscribed with stylus, re-inking is always possible. The process of re-inking consists in rubbing graphite powder with a cotton pad and cleaning the excess carbon from the surface with a cotton swab.

Birch bark or palm leaf manuscripts stuck together to form a solid block present a problem. Separation of the layers may be done by putting the sticking sheets in a bath of hot paraffin liquid. But such problems often need a careful and trained hand and should be attended to after sufficient practice is obtained in dealing with such special problems.

IV. SUMMARY OF RECOMMENDED PRACTICES

Prevention of decay and rot

Dampness, stagnant air, sunlight, hot and dry climate bring about the deterioration of records. Deleterious influence of these agents can be minimized by avoiding rooms which are damp, improperly ventilated and dark. A dry, well ventilated and suitably lighted room is needed for proper keeping of records.

Since stagnant air favours the growth of mildew which is injurious to paper and other record materials, thorough air circulation in every part of the record room is essential. Cross ventilation, provision of adequate number of electric fans and a few exhaust fans will facilitate air circulation in a record room.

Exposure of records to direct sunlight will make paper yellow and brittle. Exposure of records, even if damp, to direct sunlight should be avoided. Similarly records should not be exposed to direct heat.

Accumulation of dust among records is unhygienic and favours the growth of mildew. Regular dusting of records is necessary for keeping them in tidy condition. The ideal method of dusting records will be the use of electrically operated vacuum cleaners.

Precautions against insect attack

Breeding of insects in a record room is facilitated if there are dark and dingy places like cracks, crevices and loose joints in floor and walls. Attending to such minor defects in the room as soon as they are noticed eliminates the possibility of insects hiding in those places. Presence of edibles in the record room may attract insects and they should not be allowed in the record room.

Periodic use of insecticidal powers like D.D.T., or spray insecticides, like 'Pip' or 'Flit' at places frequented by insects, i.e.,

dark corners, walls, beneath and at the back of racks and *almirahs* is a good precautionary measure to prevent insect infestation to records. While using such liquids care should be taken that the books and records on the shelves are not directly sprayed upon since these liquids might stain or damage the records.

For fumigation of record room only those fumigants which do not have any deleterious effect on paper and other record materials should be used. Commercial fumigants which have not been so tested should not be used for fumigation of record rooms.

Naphthalene is a good deterrent to insects, and should be used among records on shelves. Naphthalene bricks weighing nearly 1 lb. each are available commercially and may be placed on shelves at a distance of every 5-6 feet.

Silver-fish which often damage the paper etc., are found on walls which are usually damp. If the records are kept in contact with damp walls, they will not only be dampened, but are likely to be damaged by silver-fish. Contact of records with walls should always be avoided. Bundles of records should not be allowed to lean against walls. Use of book-ends of suitable size should be made to keep the bundles at the ends erect.

In order to avoid contact of records with the walls, racks should be installed at least 6″ away from the wall. Keeping racks and *almirahs* away from the wall also helps cleaning of cobwebs etc., from the wall and facilitates maintenance of tidy conditions.

In case of infestation of record rooms with white ants, not only records but wooden shelves also are equally prone to damage. Therefore, as soon as any infestation is observed in a room all wooden racks should be isolated from the infested ground immediately. Painting of the legs of racks and *almirahs* with crude creosote diluted with kerosene oil (1 : 2) or keeping their legs in bowls containing creosote oil safeguards the racks, *almirahs* and the records stored there against white ant damage. Because of susceptibility of wood to decay by wet or dry rot, use of steel shelves is recommended in a record office.

Safeguard against damage in storage

Storage of documents in strong card board carton boxes provides the best condition for preservation. Since such boxes are not very easily available, records may be kept tied in bundles between two pieces of 5-ply-wood boards. These boards are not attacked by insects and are very strong. The ply-wood board used for forming a bundle should be at least 1″ larger than the size of the files so that there is no folding of the edges of the files when they are tied into bundles.

For keeping the thickness of a bundle uniform it is necessary that the stitched part of one half of the bulk in a bundle is kept in opposite direction to the other half. The bundle should be tied near both ends with uniform pressure.

The bundles should be kept on the shelves preferably in horizontal position. If they are kept vertically, care should be taken to see that the bundle rests on ply-wood edges and that there is no folding or curving of the edges of the record files.

The bundles should always be lifted from the shelves lightly and should never be pulled or dragged out from their position. A depth of 12″ is recommended for normal bundles. Outsize bundles should be bifurcated into two bundles of convenient size.

All minor folds or tears in the papers of a file should be immediately attended to. Damaged covers should be replaced with new ones. For all repair work binder's paste (starch paste) or dextrine paste should be used. Gum and glue should never be used for repair or mending. Scotch tape or commercially available transparent sheets in which adhesive is incorporated during manufacture should never be used for mending tears, etc., since the adhesive may subsequently decompose and damage the paper.

A general principle of record repair is that nothing should be done which cannot be undone.

Precaution against fire in a record room

Use of match-stick or open flame of any kind may accidenttally result in fire. Smoking should be strictly prohibited in a

record room and lighting of match-stick or carrying an open flame should be banned.

Record room should be provided with adequate fire fighting equipment. Carbon dioxide (gas type) fire extinguishers are suitable for record rooms and should be placed at convenient places.

Entry of personnel in the record room should be restricted.

Windows and ventilators should be covered with wire net frames to safeguard against any sabotage or pilferage.

APPENDIX I

SPECIFICATIONS OF WRITING INK AND PAPER FOR PERMANENT RECORDS

Record Ink

Ferrogallotannate, Blue Black Ink containing not less than 0.4 gm of Iron per 100 c.c. of the fluid ink is recommended for permanent records. Specifications for such an ink are given in IS : 221-1950 : *Specification for Fluid Ink for Registration and for Cheques and for Records,* issued by the Indian Standards Institution.

Writing Paper For Permanent Records

Detailed specifications have not been so far issued by the Indian Standards Institution. The following tentative specifications have been agreed to by the Quality Control Sub-Committee of the Paper Sectional Committee of the Indian Standards Institution for good grade paper.

A. *Chemical Requirements*

1. Rag content (cotton. linen singly or mixed)	100%
2. Alpha cellulose content	85% minimum
3. Copper number	2% maximum
4. Ash content	2% maximum
5. Rosin content	1.5% maximum
6. pH	5 minimum

B. *Physical Requirements*

1. Burst Factor	25
2. Folding Endurance	Minimum 250 double folds average each direction at 1 K.G. tension under I.S.I. test conditions (*Method of Sampling and Test for Paper and Allied Products,* Part I, IS : 1060-1956).

C. *Ageing Test* (Heating for 72 hours at 103° ± 2 °C)

1. Retention of Alpha Cellulose	98% minimum
2. Increase in Copper Number	Not more than 0.5
3. Percentage of the un-aged folding strength retained by the sample after ageing	70% minimum

D. *General Requirements*

The paper shall be uniform in formation, thickness and substance, evenly finished, and free from specks, holes or other blemishes. It shall be suitable for ruling and writing with ink, and shall not show appreciable change in shade after being subjected to ageing test.

APPENDIX II

Specifications of Repair Materials

Hand-made Paper

Hand-made paper for repair of records shall be all rag, white or cream-toned. If the paper is cream-toned the dyes used shall be fast to light. Its weight shall be 20-22 lbs. (size 20″× 28″, 500 sheets) and its pH not less than 5.0.

It shall have a folding endurance of at least 500 double folds at 1 K. G. tension under I.S.I. test condition.

(*Method of Sampling and Test for Paper and Allied Products,* Part I. IS : 1060-1956).

Tissue Paper

Tissue paper for repair of records should conform to the following requirements :—

Alpha cellulose content not less than 88%

Weight and size : 6-7 lbs. (25″×50″, 500 sheets).

Ash content not more than 0.5%.

pH not less than 5.0.

The tissue paper shall be free from oily and waxy constituents.

Chiffon

Chiffon used in repair shall be fine, pure and white silk gauze, having a mesh count of 83 ×82 per square inch.

It shall have a thickness of 0.0034″ (average) and a pH of 6.0-6.5.

Oiled Paper and Waxed Paper

The oiled and waxed paper shall be resistant to water penetration, and shall not show adhesion with dextrine or starch pastes. Its oily and waxy constituents shall not stain the document. Recommended weight is as under :—

Oiled Paper : 50 lbs. (24″×18″, 500 sheets)

Waxed Paper : 40-42 lbs (36″× 36″, 500 sheets)

Muslin (*Malmal*)

Muslin used for mounting of maps and charts of medium size (larger than double foolscap) shall be of fine, bleached quality, having an average thickness of 0.004″, and mesh count 90 × 70 (approximately) per sq. inch. It shall be of even weave and free from knots etc., in the threads, and shall preferably be free from sizing materials.

Long-cloth

Long-cloth used for mounting maps and charts of heavy weight shall be of fine bleached quality, having average thickness of 0.006″ and mesh count 90 × 70 (approximately) per sq. inch. It shall be of even weave, free from knots etc., in threads, and preferably shall not contain sizing materials.

Cellulose Acetate Foil

Cellulose acetate foil for lamination of records is normally available in 42″ width, but may also be supplied in sheets cut to desired size.

The formula of the cellulose acetate foil recommended for use in lamination of records by the National Bureau of Standards, Washington, is P. 911, manufactured by M/s. Celanese Corp. of America.

The cellulose acetate foil recommended for lamination should have a thickness of 0.00088″, should be flexible, semi-moisture proof and should not change in colour and flexibility when subjected to accelerated ageing at 103°±2° C for 72 hours. It should be free from nitrate, and should have a stable plasticizer.

APPENDIX III

Formula and Preparation of Dextrine Paste

Formula

Dextrine	..	5 lbs.
Water	..	10 lbs.
Oil of Cloves	..	1¼ oz.
Saffrol	..	1¼ oz.
Lead Carbonate	..	2½ oz.

(Lead carbonate can be replaced by barium carbonate).

Procedure

Water is kept for boiling in a shallow brass vessel (*degchi*). When the temperature of water has risen to about 90 °C, dextrine powder is slowly added to the hot water with constant and vigorous stirring so that formation of nodules of dextrine in water is avoided. After the addition of dextrine is complete (5 lbs. of dextrine may take approximately 30-40 minutes), lead carbonate is added to the paste while stirring. Then oil of cloves and saffrol are added, well mixed with the paste, and the preparation of the paste is completed by cooking over fire for 6-8 minutes only.

Formula and Preparation of Thin Starch Pastes

Formula

Starch (*Maida*)	..	½-¾ lb.
Water	..	10 lb.
Oil of Cloves	..	1¼ oz.
Saffrol	..	1¼ oz.
Lead Carbonate	..	2½ oz.

(Lead carbonate can be replaced by barium carbonate).

Procedure

The same as described above dextrine being replaced by starch (*maida*).

Formula and Preparation of Starch (*Maida*) Paste for General Repair and Binding Work

Formula

Starch	..	1 pt. by weight.
Water	..	4-5 pts. by weight.
Copper Sulphate	..	2.5-3% of starch.
Glycerine	..	1-2% of starch.

Preparation

Small quantities of starch (*maida*) are mixed with water (requisite quantity) taken in a shallow brass vessel (*degchi*) and made into a paste taking care that no lumps or nodules are formed at the base. After the requisite quantity of starch has been so mixed, copper sulphate dissolved in minimum quantity of water (10 c.c. for every 5 gm.) is added to the paste. The paste so prepared is then cooked on fire or electric stove till it starts frothing. During cooking, paste is kept well stirred so that there may not be any charring of starch at the bottom due to over-heating. Glycerine is mixed to it at this stage and the paste well stirred.

APPENDIX IV

Repair Equipment Required in a Record Office

1. Repairing table, preferably with glass top
2. Small hand press
3. Paper trimmer
4. Scissors (long)
5. Knives
6. Paring knives
7. Cups (Brass)
8. Dishes (Brass)
9. Brushes (Camel hair, 1″ and -½″ wide)
10. Paper cutting slices (preferably made of horn)
11. Foot-rule
12. Sewing needles (big and small)
13. Bodkin (for piercing holes)
14. Enamelled trays
15. Glass plates
16. *Degchi* for preparing dextrine and *maida* paste
17. Electric iron.

APPENDIX V

Special Care of Leather Bound Volumes

Good quality vegetable tanned leather is ordinarily a very stable substance, but in adverse circumstances it is liable to be attacked by insects and fungi. It contains waxy and greasy constituents which gradually volatilize in hot climate, and thus leather often loses its flexibility in course of time.

The durability and longevity of leather can be greatly enhanced by the application of leather preservative dressing to leather bound-volumes. Many varieties of leather preservative dressings are available. However, a mixture prepared with the following formula has been found quite satisfactory :—

1. Lanolin anhydrous	..	9 oz. (Avoir)
2. Bees-wax	..	½ oz. (Avoir)
3. Cedarwood oil	..	1 oz. (Fluid)
4. Benzene	..	11 oz. (Fluid)

Benzene is slightly heated and the wax is dissolved in it. Cedarwood oil is added next and then lanolin, which should be previously softened by warming. The mixture should be thoroughly shaken before using.

The reasons for combining these ingredients in this leather dressing are as follows : Lanolin is an animal fat which is easily absorbed by leather, and does not become rancid. At ordinary temperature it is in the form of a thick grease and its use will be difficult. Its application is made easy by mixing it with the liquid dressing. The wax will assist in polishing and providing a thin surface film and will reinforce any powdery or cracked portion of the leather. The cedarwood oil is a good preservative and is useful in forming a bond of union between the lanolin and wax in the leather. Benzene is chosen as a convenient "thinner" as it readily dissolves bees-wax.

Since acidity in the leather or in the atmosphere is injurious to it, and accelerates its decomposition, treatment of leather with

a buffer salt (sodium benzoate) prior to application of preservative dressing is recommended. The process of treatment is as follows :—

Superficial dust particles are first cleaned from the leather binding with a clean and soft cotton cloth. A wet swab dipped in 1-2% sodium benzoate solution is applied to it and allowed to dry. After the leather is dry, leather preservative dressing is applied to it with a brush and the volume is again left to dry (overnight). The leather dressing is then well rubbed in with cotton or cloth pad. Leather so treated retains its natural shine and flexibility.

The mixture is highly inflammable and should be kept away from fire.

APPENDIX VI

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